



TASK 1 REPORT (R1)
IDENTIFICATION OF
CHEMICALS AND RADIONUCLIDES
USED AT ROCKY FLATS
MARCH 1991





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MEMORANDUM

DATE: April 2, 1991
TO: Rocky Flats Health Advisory Committee
FROM: Steve Ripple *SR*
SUBJECT: TASK 1 REPORT

Normie has asked that I distribute copies of the revised Task 1 report. The changes reflect your comments from the January HAP meeting. We received no further comments from the public.

The primary changes to the report are:

- The insertion of a summary at the beginning of the report,
- The removal of some of the information listings from the text and placement of them in tables (Section 4),
- Brief discussion of the general nature of information considered classified (Section 2),
- Notation that inventory quantities for beryllium are incomplete (Table 4-1), and
- Some minor corrections to the chemicals listings for consistency and accuracy (Appendices A, B, and C).

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DOSE

RECONSTRUCTION PROJECT

Phase I of the Health Studies

ROCKY FLATS



PROJECT BACKGROUND

ChemRisk is conducting a Rocky Flats Toxicologic Review and Dose Reconstruction study for The Colorado Department of Health. The two year study will be completed by the fall of 1992.

The ChemRisk study is composed of twelve tasks that represent the first phase of an independent investigation of off-site health risks associated with the operation of the Rocky Flats nuclear weapons plant northwest of Denver. The first eight tasks address the collection of historic information on operations and releases and a detailed dose reconstruction analysis. Tasks 9 through 12 address the compilation of information and communication of the results of the study.

Task 1 will involve the creation of an inventory of chemicals and radionuclides that have been present at Rocky Flats. Using this inventory, chemicals and radionuclides of concern will be selected under Task 2, based on such factors as the relative toxicity of the materials, quantities used, how the materials might have been released into the environment, and the likelihood for transport of the materials off-site. An historical activities profile of the plant will be constructed under Task 3. Tasks 4, 5, and 6 will address the identification of where in the facility activities took place, how much of the materials of concern were released to the environment, and where these materials went after the releases. Task 7 addresses historic land-use in the vicinity of the plant and the location of off-site populations potentially affected by releases from Rocky Flats. Task 8 activities will quantify the doses of the materials of concern received by off-site populations.

ChemRisk will also perform four more tasks involving the compilation of project information and community relations. Activities from Tasks 9, 10, and 11 will result in the establishment of systems to manage the data from the study, compile a bibliography of references, and place the information in a repository for use in further studies. Task 12 activities will involve the Rocky Flats community in the study by means of interviews, health advisory panel meetings and public meetings.

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**TASK 1 REPORT
MARCH 1991**

SUMMARY

This first task in the Rocky Flats Toxicological Review and Dose Reconstruction (TR/DR) project involves the preparation of a listing of the radionuclides and chemicals that have been used or produced at Rocky Flats since operations began in 1952. This document details the information repositories utilized, the documents reviewed, and the individuals interviewed in the generation of the radionuclide and chemical lists.

The list of radionuclides identifying over 50 substances believed to have been used at the facility since operations began is presented in the body of the report. The listing of chemicals is found in four appendices. Together the four appendices identify more than 8,000 chemicals or products that have been used at the Rocky Flats Plant. The appendices represent four major groupings of compounds: 1) chemicals that should be subjected to further evaluation to identify the compounds of concern (Priority 1, Appendix A); 2) tradename products (Priority 2, Appendix B); 3) tradename products and chemicals that are believed to have little or no potential for posing an off-site health hazard (Priority 3, Appendix C); and 4) gases and miscellaneous chemicals (Appendix D).

This report also identifies various categories of compounds used by the plant such as carcinogens, herbicides, chemicals identified as major use or of principal concern, and additional substances found through document searches.

Through the review of a considerable number of documents and inventories ChemRisk was able to determine that the Rocky Flats Plant maintained a fairly complete and consistent record of radionuclide use. However, plant records of chemical use are generally limited to the time period after 1970.

1.0 INTRODUCTION

This first task in the Rocky Flats Toxicologic Review and Dose Reconstruction (TR/DR) project involves the preparation of a list of the radionuclides and chemicals that have been used or produced at Rocky Flats since operations began in 1952. The initial version of the list, presented in this Task 1 report, encompasses more than 50 radionuclides and more than 8000 chemicals and product names.

The Task 1 scope was developed to permit the identification of chemicals and radionuclides that have been present at the Rocky Flats Plant and warrant study for their potential historical impact on off-site individuals. To accomplish this objective an effort was made to survey the major repositories of information related to Rocky Flats. Much of this report provides details on the nature and extent of the information available from these repositories and from persons with knowledge of the plant's historic operations. The documents contained in these various repositories number in the thousands, and clearly could not all be reviewed. However, efforts were directed at the identification of those documents that would contribute to the production of the most comprehensive list possible with an emphasis on the identification of those compounds that have been present in substantial quantities at the site.

The list generated by this task will serve as the basis for the selection in Task 2 of those radionuclides and chemicals representing the greatest concerns from a community exposure standpoint and which will be further studied in detail during the remainder of the TR/DR project. The total number of compounds that will be investigated in detail was anticipated to be 15 when the study was designed.

2.0 BACKGROUND

Several repositories of Rocky Flats Plant documentation have been identified that will be of use to the TR/DR Project. The majority of them are not open to the general public because various levels of security clearance are required to access them. With the exception of the Building 881 archives at the plant, ChemRisk team members have accessed the contents of each of the limited-access repositories listed below:

- The Environmental Master File
- The Plant Library
- Integrated Research File
- The Legal/Environmental File
- The Classified Archives (Building 881)
- The Federal Records and Archives Center
- The DOE Technical Library
- U.S. DOE Effluent Information System
- U.S. DOE On Site Discharge Information System

In addition, ChemRisk team members have reviewed documents contained in the following public repositories:

- The Rocky Flats Public Reading Room (at the Front Range Community College)
- The Rocky Flats Environmental Monitoring Council Library (in Golden, CO)
- The Colorado Department of Health (CDH) Air Division Files
- The CDH Hazardous Materials and Waste Management Division Files

- The CDH Water Quality Division Files
- The CDH Radiation Control Division Files

The nature and content of these repositories are discussed in the following sections.

The Environmental Master File (EMF):

The EMF consists of powered horizontal file machines in Trailer 130 C at the plant site. According to one of the current caretakers, about 75% of the contents have been catalogued and arranged according to a numbering system. The main file machine has 16, 6-foot-long shelves. Two of the shelves have locked fronts, which may contain documents related to the Church litigation.

The card catalogue to the EMF consists of approximately 5 linear feet of 3 x 5 cards, arranged alphabetically by topic. Each card contains up to 12 entries, and a single document may be listed under several topics, appearing more than once in the catalogue. A scan of the cards revealed that the majority of the documents were authored between 1970 and 1980. The documents include Rocky Flats-specific memos, letter reports, and studies; copies of state and federal regulations; and DOE reports. The plant librarian indicated that the EMF was originally set up around 1975, primarily to address the everyday administrative and informational needs of the Environmental group. Approximately 90 documents from the EMF were reviewed prior to preparation of this report.

The Plant Library:

The library is located in Building 706 in the Plutonium Security Zone (PSZ), which requires a Q-clearance and additional authorization (demonstrable need) to gain access.

The Library is physically made up of the hard-copy collections of 1) the Integrated Research File, 2) various journals and scientific magazines, 3) reference materials such as textbooks, handbooks, manuals, monographs, and reports generated by outside institutions/individuals, and 4) indexes and abstracting tools. The Legal/Environmental File was located here at one time, but was moved to Las Vegas for copying. The two files of interest to the TR/DR Project that are in the library are described below.

Integrated Research File: This database was started around 1975 and contains only technical reports - no letters, memos, etc. This file has two separate holdings - classified and unclassified. The classified holdings also have levels of secrecy for various types of documents, known as sigma levels. The sigma level assigned to a document generally indicates how much information the document contains regarding design/theory of nuclear weapons. Sigma-level One is the highest security level. Access to Sigma-level documents is on a need-to-know basis. The document titles and summaries of the classified holdings (accessed through the VAX) may be classified information themselves.

The RF Legal/Environmental Index (LEI): This is an index only. The actual files (sometimes loosely referred to as the Church Litigation Files) were at one time located in the plant library, but are now in Las Vegas undergoing copying for preservation and will be returned to the plant. None of the information in the files is classified. However, the index of the files is Attorney-Client privileged, as it includes comments on the pertinence of each document to the attorney's strategy. The files were established in approximately 1975 by attorneys as a result of a lawsuit brought by a neighboring landowner. Apparently, the attorneys canvassed the plant for any and all documents that dealt with environmental issues and compiled them. Memos, letters, reports, etc. were included. Classified documents were not included. The plant librarian indicated that the files consist of an estimated 20,000 documents (five 4-drawer filing cabinets) dating from 1952 to approximately 1975.

There are four indexes of materials in the library that can be accessed through the plant's VAX computer system: the Integrated Research File Index, the Legal/Environmental Index, the Rocky Flats Journal Holdings Catalogue, and an Environmental Regulations (Federal and State) database.

Classified Archives, Building 881:

Inactive classified documents are kept in the archives in Building 881. However, there may be inactive classified documents in the various areas throughout the plant (active classified documents would probably be in the area of the generating/user group). These files were not reviewed for the purposes of this report. It is reported that there are approximately 1500 boxes of classified documents in the 881 Archives which have been catalogued to some degree. The nature of the information that is being sought for the purposes of this study (i.e., identity of chemicals and radionuclides and their release rates) is not considered to be classified information by itself. As a general rule, only information specifically related to the design of a weapon or production rates is considered classified. Therefore, classified repositories may not provide much useful information for the purposes of this study. However, information relevant to this study may be present in reports that also contain classified information, and, for this reason, future project efforts will be directed at reviewing the classified repositories.

Federal Records and Archives Center, Denver Federal Center:

The Federal Records and Archive Center is where inactive, unclassified documents are stored until their specified retention period expires. The retention time for each of the various types of documents is specified under a protocol established by the National Archives and Records Administration. For the Rocky Flats plant documents, the General Records Schedule and the DOE Records Schedule govern the record retention times. No classified documents are sent here, as they must remain on the plant site.

The Rocky Flats documents on file here cover the periods when the nuclear weapons complex (nuclear policy) was governed by the AEC (Atomic Energy Commission), the ERDA (Energy Research and Development Agency), and the DOE. Documents are segregated into groups, according to the governing agency at the time of the document's creation. Specifically, documents in group 326 are from the AEC era, and groups 430 and 434 represent the ERDA and DOE eras, respectively. Rocky Flats began submitting records to the Federal Records Center in the '60's, although some of the documents are from earlier dates.

A listing called an "Accession Number Master List" contains the type and amount (in cubic feet or number of boxes) of documents on file for each group. The entries on the list indicate the general type of documents the boxes contain, but do not provide the titles of the documents. From the Accession Number Master List, one turns to the "Standard Form 135" of an accession number to find out more specifically what is contained in the boxes; although the information even on these forms is rather generic. Access to these listings is uncontrolled, but access to the files themselves requires approval from the plant records group and possibly from the department that generated the documents. Some of the files at the Federal Records Center have been "frozen" by court order and can not be accessed at this time.

The October printout of the Accession Master Number List indicated 622 cubic feet (boxes) of documents from the AEC era, 277 cubic feet from the ERDA era, and 2338 cubic feet from the DOE time period. The number of documents at the Federal Records Center fluctuates as a result of the various retention times for the documents on-hand and the submission of additional documents from the Plant. Twenty-five boxes of documents from the AEC era were reviewed for the purposes of this report.

At the Plant there is a cargo container of records (164 boxes) with the Health, Safety and Environment group that is to be processed and sent to the Federal Records Center. The index of the boxes, five pages long and not very detailed, is much like the Standard Form 135. The processing and transferring of these records to the Federal Records Center is on hold until funding is available.

DOE's Germantown, Maryland Library:

The DOE technical library is supposed to receive all unclassified technical reports from DOE facilities. Literature searches performed at the library for the purposes of this task suggest that at least some of the Rocky Flats reports, such as the Annual Environmental Monitoring Reports, are missing. Data summary reports can generally be found in this library, rather than detailed monitoring reports. The library may also be useful for obtaining technical reports addressing specific accidents or incidents at the Rocky Flats Plant.

U.S. DOE Effluent Information System & U.S. DOE On Site Discharge Information System:

These are databases maintained by EG&G in Idaho Falls, Idaho for DOE that contain data on radionuclide releases for all DOE facilities on an individual release point basis. The content of these databases were briefly reviewed for the purposes of this task.

Rocky Flats Public Reading Room at the Front Range Community College:

The reading room contains a variety of regulatory compliance documents and plant reports that the plant has released to the public after removing sections containing

classified information. A listing of the contents of the reading room is updated regularly. Many of the documents in this repository were reviewed for the purposes of this task.

Rocky Flats Environmental Monitoring Council Library:

Documents in this library duplicate many of those found at the Front Range Community College. No index is currently available for the information contained in this library. Numerous documents in this repository were reviewed for this task.

CDH Air Division Files:

These files are located on the third floor of the Ptarmigan Building in Denver, and consist of information on chemical emissions from the Plant. The total volume of records are contained in three horizontal file drawers. Most of the information is relatively recent, with an estimated 85% of the documents dating back only to 1989.

The Air Division has recently established an inventory of emission points at the Plant, and has compiled the information in a database in order to produce a quarterly status report. Only two editions of the quarterly report had been prepared at the time of this review. There are two versions of the report; the full-length version, and the condensed version which contains only those emission points that are of concern to the Division or warrant further investigation. The documentation includes building-by-building files (approximately 230 individual files) that were set up in anticipation of future information to be placed there. Most of these files contain only a single page of a summary form for each of the buildings. Several documents were retrieved from this repository for Task 1.

CDH Hazardous Materials and Waste Management Files:

There are two sets of files that have been identified at the Department of Health offices at 4210 E. 11th in Denver that contain Rocky Flats documents: RCRA files in the Waste Management Division; and SARA Title III, Underground Storage Tank, and Solid Waste files in the Hazardous Materials Division.

The Waste Management Division's files are located on the third floor. Many of the documents in this repository have also been found in other repositories. The volume of Rocky Flats-related files is roughly equal to six, 4-drawer file cabinets. A cataloging/indexing scheme was recently established for these files.

The Hazardous Materials Division's files are in the basement of 4210 E. 11th. The Division's files basically include documentation concerning SARA Title III, Underground Storage Tank, and Solid Waste regulations. Rocky Flats has submitted documents under SARA Title III reporting requirements that include MSDSs for Section 313 and 302 materials (>10,000 lbs, or Extremely Hazardous Materials in excess of 500 lbs), and Tier 2 documentation. Several of these documents were reviewed for Task 1. Documents have been submitted by Rocky Flats authorities in compliance with the underground storage tank regulations, but these files are confidential at the request of Rocky Flats. The files date back to the enactment of the UST regulations (1986).

Solid waste reports have also been provided to CDH by Rocky Flats, but the files have been removed, presumably to CDH's Rocky Flats Program Unit or the Waste Management Division's files.

CDH Water Quality Division Files:

These files have not yet been reviewed as their relevance to Task 1 is limited. They address only surface water information, and are almost exclusively limited to the Monthly Data Exchange Reports. These files are in the CDH offices in the 1st National Bank Building at 400 S. Colorado Blvd in Denver. There is another set of files located with the Drinking Water Section, but they are focused on the reservoirs only.

CDH Radiation Control Division Files:

Division records reviewed for the purposes of Task 1 covered the period from approximately 1970 through 1987. These records are located in the Waste Management Library on the third floor of the West Tower of the Ptarmigan Building in Denver. These files consist of approximately four shelves of documents made up primarily of monthly plant reports, information exchange meeting notes, and CDH monthly monitoring reports. More specifically the reports include:

- Daily weather summaries covering various periods during the years 1970 to 1974.
- Monthly weather summary for the years 1969 to 1975 (when data reporting was automated).
- Environmental Survey Reports, including minutes and handouts from the information exchange meetings including:
 - Plant Calendar Year Summary - 1969
 - Facility Monthly Reports of monitoring data on; integrated stack releases, monthly average stack concentrations, ambient air on and off-site, high volume air samples (continuous and grab), fallout trays, holding pond water, soils, vegetation, well waters, and waste treatment facility effluent.

- CDH Monthly Monitoring Reports for the years 1975 through 1987 including:
 - Ambient air on and off-site,
 - Surface and tap water, and
 - Well water.

Division records for more recent years are kept at the Division's offices at 4210 E. 11th in Denver.

3.0 LIST DEVELOPMENT

Periodic reports and inventories containing information about radionuclide and chemical use have been generated since about the mid-1970's by the plant. In the case of radionuclides, the inventories were routinely generated and were intended to be comprehensive. Chemical reporting was not routine and, until recently, was generally not comprehensive. These inventories represent the best source of information identified to-date regarding radionuclide and chemical use and are the primary sources for the lists of compounds presented in this Task 1 report. The continuity of the nature of the operations at Rocky Flats and the comprehensiveness of some of the post-1970 information sources suggest that the lists presented in this report encompass the vast majority of radionuclides and chemicals that have been present at the site.

Reliable information on radionuclide and chemical use at Rocky Flats prior to the 1970's has been difficult to find because data are very limited and the records are scattered. If significant use of additional radionuclides or chemicals not identified by this initial project task is identified during subsequent tasks they will be considered for further study at that time.

The lists of radionuclides and chemicals present at the site have been developed using a variety of sources of information. An initial list was rapidly compiled from a few key documents that provided a relatively comprehensive inventory of radionuclides and chemicals. Subsequent efforts focused on identification, retrieval and review of other documents from the numerous repositories to supplement the listing and on efforts to find more information regarding operations during the 1950's and 1960's. The following sections describe the process used and the sources that were consulted in the development of the lists.

3.1 Radionuclides

The presence of radionuclides at the Rocky Flats plant has been documented throughout the plant's operational history. The quality of the record is relatively poor prior to 1964, since before that time many people had the authority to order non-production radionuclides (presumably small quantities). Starting in 1964, a formal program was created whereby a Health Services Radioactive Source Registry was established for non-production radionuclides. This registry is maintained in a computer data base for registered sources and non-accountable sources and contains comprehensive information on each radionuclide source. Radionuclide inventories, containing general source information, have been published on a quarterly basis by the Department of Operational Health Physics since 1978. The first few of these reports, which included both production and non-production radionuclides, were created by searching laboratory and production records.

The primary sources of information for the listing presented in this report were the Health Physics Reports and a periodic report titled, "Radioactive Materials Associated With Rocky Flats Plant," which contain lists of all production and non-production radionuclides

used at the Rocky Flats Plant. Reports from 1978 through 1981, 1983, and 1989 were reviewed. The completeness of the listing generated from these reports was evaluated by reviewing other plant reports and environmental monitoring reports. The documents in this review included:

- The Rocky Flats Plant Annual Environmental Monitoring Reports for 1976 through 1981, 1984 through 1986, and 1988,
- The Rocky Flats SAR, Chapter 10, Environmental Monitoring Program, 1981,
- The Radioactive Effluent/On Site Discharges/Unplanned Releases Report for 1988 (DOE Form F-5821.1),
- The Rocky Flats Plant Monthly Environmental Monitoring Reports (January 1984 through April 1990),
- The Environmental Measurements Laboratory Annual Report of the Surface Air Sampling Program, 1985 (EML-440),
- The History of Rocky Flats Waste Streams, 1982,
- History and Evaluation of Regional Radionuclide Water Monitoring and Analysis at the Rocky Flats Installation, February 1981 (RFP-3186),
- Investigation of Tritium Release Occurrence at the Rocky Flats Plant, November 1973 (TID-27810),
- Colorado Department of Health, USAEC Rocky Flats Plant Surveillance; August 1970 through March 1975.
- U.S. DOE Effluent Information System, Nuclide Database Master List for Calendar Years 1953 to 1989.
- U.S. DOE On Site Discharge Information System, Nuclide Database Master List for Calendar Years 1953 to 1989.

Additional information was gathered from interviews with current Rocky Flats Plant employees.

The reporting of radionuclides present at the plant site is typically broken down into three groups defined by the gross quantity of material handled. The first group includes radioactive materials handled in kilogram quantities and used in production activities. The second group includes radioactive materials handled in gram quantities, primarily for research and analytical activities. The final group includes other radionuclides (e.g., sealed solid sources, plated sources, liquid sources, and analytical stock solutions) used for research, analytical, and calibration activities. This last grouping contains two categories of sources. The first are the registered sources which require semi-annual leak tests and physical audits and include sealed solid sources greater than ten microcuries, plated sources greater than one microcurie, and liquid sources greater than one microcurie. The other category is the accountable sources which require annual accountability and include sealed solid sources less than ten microcuries, plated sources less than one microcurie, liquid sources less than one microcurie, and analytical stock solutions.

The list of all radionuclides, identified to date, that have been used or stored at the Rocky Flats Plant is presented below. Each radionuclide is listed only in the quantity category representing the highest quantity present at any time at the plant. Tritium is normally present in quantities of much less than one gram. However, there was an incident in 1973 that resulted in an off site release of tritium from scrap material contamination. An AEC investigation committee concluded that the maximum contamination of the scrap material with tritium was 2000 Curies as reported in a document titled, "Investigation of the Tritium Occurrence at the Rocky Flats Plant ". Consequently, tritium has been included with the radionuclides on the gram quantity list.

Radioactive Materials at the Rocky Flats Plant

Radioactive Material Handled in Kilogram Quantities

Americium-241

Plutonium

Pu-238

Pu-239

Pu-240

Pu-241

Pu-242

Thorium-232

Uranium

U-233

U-234

U-235

U-238

Radioactive Material Handled in Gram Quantities (<1 Kg)

Curium-244

Hydrogen-3 (Tritium)

Neptunium-237

Thorium-228

Other Sources

Includes sealed solid sources, plated sources, liquid sources, and analytical stock solutions.

Actinium	Ac-228	Strontium	Sr-85, 89, 90
Aluminum	Al-26	Technetium	Tc-99, 99m
Americium	Am-243	Thallium	Tl-204
Antimony	Sb-124, 125	Thorium	Th-230, 231, 234
Argon	Ar-39	Tin	Sn-113
Barium	Ba-133	Uranium	U-232, 236
Beryllium	Be-7	Ytterbium	Yb-169
Bismuth	Bi-207, 210	Yttrium	Y-88, 90
Cadmium	Cd-109	Zinc	Zn-65
Californium	Cf-250, 251, 252		
Carbon	C-14		
Cerium	Ce-139, 144		
Cesium	Cs-134, 137		
Chlorine	Cl-36		
Cobalt	Co-57, 60		
Curium	Cm-245, 246		
Europium	Eu-152, 154, 155		
Holmium	Ho-166m		
Iodine	I-129, 131		
Iridium	Ir-192		
Iron	Fe-55		
Krypton	Kr-85		
Lead	Pb-210		
Manganese	Mn-54		
Mercury	Hg-203		
Nickel	Ni-63		
Plutonium	Pu-236, 244		
Polonium	Po-210		
Potassium	K-40		
Promethium	Pm-147		
Protactinium	Pa-231, 234		
Radium	Ra-226		
Ruthenium	Ru-106		
Selenium	Se-75		
Silver	Ag-110, 110m		
Sodium	Na-22, 24		

Interviews with a plant employee and review of the Rocky Flats Legal/Environmental File and Environmental Master File documents have suggested that Thorium-233 and Thorium 227 may also have been present at one time at the site. However, ChemRisk has been unable to establish the accuracy of these reports. Further investigation will be necessary to confirm the presence and quantity of these radioisotopes at the plant site.

3.2 Chemicals

The starting point for preparing the list of chemicals used or produced at Rocky Flats was a computer database containing one of the latest Rocky Flats Chemical Inventory Lists which was obtained from the Environmental Restoration and Waste Management Group at Rocky Flats. This list is an updated version of the 1988-1989 Chemical Inventory List on file in the Rocky Flats Public Reading Room. The inventory is the result of a survey of the chemicals present and respective quantities in every building on the plant site, supplemented with information from purchasing records. The individuals preparing the resulting listing submitted it to the area managers at the plant for verification.

The only other major inventory of chemicals identified by our investigations is one prepared by Dow Chemical Company in January of 1974. The Dow inventory represents a compilation of separate inventories conducted in all the plant areas and is titled "Harmful and Potentially Harmful Materials Inventory, January 25, 1974". The inventory was to include materials considered to be directly harmful to people found in amounts greater than 3 grams, and materials considered to be harmful only when grossly mis-handled or potentially harmful in the environment if found in amounts greater than 4 kilograms. The inventory states that all areas were physically inspected and estimates

(within $\pm 30\%$ of the amount) were permitted. The inventory excluded "special and source" materials, inert gases, air and potable waters.

The chemicals and their quantities as presented in the 1974 and 1988/89 inventories are presented in Appendices A, B and C. The plant inventories presented quantity information in many different forms (e.g. gallons, pounds, milligrams, kilograms). In order to facilitate the comparison of these various quantities, they were all converted to kilograms using the following conversion approximations:

- 0.264 gallons per kilogram,
- 1.0 liter per kilogram,
- 2.2 pounds per kilogram,
- 1,000 milliliters per kilogram,
- 33.3 ounces per kilogram,
- 2.1 pints per kilogram, and
- 1.057 quarts per kilogram.

Appendix D contains a listing of materials found on the 1988/89 inventory that are either gases or items for which no quantitative information was available.

The chemical list has been divided into three major groupings in anticipation of the first screening step required by Task 2 which addresses the selection of the compounds of concern. The assignment of compounds to these listings will be finalized as part of Task 2. The first major grouping (Appendix A) represents those chemicals that should be subjected to further evaluation to identify the compounds of concern (Priority 1). The Appendix A list is composed of two alphabetical listings. The first list is those chemicals found on the 1988/89 inventory. This first list also identifies quantities for those

chemicals that were also on the 1974 inventory. The second list identifies those chemicals that are unique to the 1974 inventory. The second grouping (Appendix B, Priority 2) is comprised of trade name products placed into two listings as was done in Appendix A. These products have been listed in order of the quantity reported (when available) in the inventories. Identification of the chemical makeup of products used in large quantities is one objective of the Task 2 efforts. The third list (Appendix C, Priority 3) identifies tradename products and chemicals that are believed to have little or no potential for posing an off-site health hazard and is organized in the same fashion as the Appendix A and B listings. Materials were placed on the Appendix C listing if they fell in one of the following categories:

- Common household or commercial products,
- Chemicals likely to be used as laboratory standards or analytic testing materials (typically listed in very small quantity), or
- Considered to be generally non-toxic or of very low toxicity.

4.0 SUBSIDIARY LISTS

Appendices A, B, C and D together provide a comprehensive list of the chemicals and brand name products that have been reported as being present at Rocky Flats. Because the comprehensive list is so extensive, several categories of substances are discussed separately in this section to provide an overview of the types of compounds represented on the comprehensive list.

4.1 Listed Carcinogens Present at Rocky Flats

Tables 4-1 and 4-2 identify those chemicals on the 1988/89 and 1974 inventories respectively that are listed as carcinogens on the Health Effects Summary Table B: Carcinogenicity (updated 3rd quarter 1990) of the U.S. EPA "Health Effects Summary Tables and User's Guide". The inventories include over 80 chemicals and elements that have been identified by the EPA as possible, probable or known human carcinogens. Of these compounds 23 were reported in inventory quantities that exceeded one kilogram and 15 were reported in quantities exceeding ten kilograms. It should be noted that beryllium and possibly a few other metals have special status as production materials at the plant, and that more recent inventories do not include complete quantitative information for these elements.

4.2 Herbicides Used at Rocky Flats

Investigations led to the identification of documents addressing herbicide use at the plant. A document in the Rocky Flats Reading Room titled "List of Herbicides Used at the Rocky Flats Plant August, 1989", and two documents from the Environmental Master File; Pesticides Control Program Report (EMF # 60-12240-RR-001) and Weed Spraying Operations (EMF# 60-12240-CO-002) listed a number of compounds not found in the inventories. Neither of these documents or the inventories identified atrazine, which was the subject of concerns as the result of a fairly recent release. The herbicides and pesticides identified by these documents are listed in Table 4-3. No information on the quantity of the pesticides and herbicides was provided in these documents.

TABLE 4-1
CARCINOGENS AT ROCKY FLATS
FROM 1988/1989 INVENTORY

Chemical	Quantity (Kilograms)	Chemical	Quantity (Kilograms)
Acrolein	0.005	1,1 Dimethyl Hydrazine	0.010
Acrylamide	0.010	Dioxane	31.5
Acrylonitrile	0.015	Epichlorohydrin	0.010
Aldrin	0.003	Ethyl Acrylate	0.010
Allyl Chloride	0.010	Ethylene Chloride	11.9
Aniline	0.473	Flourene	0.015
Aroclor	0.122	Formaldehyde	146
Arsenic	3.06	Heptachlor	0.003
Asbestos	0.572	Heptachlor Epoxide	0.001
Benzene	5.97	Hexachloro Benzene	1.02
Benzo-a-pyrene	0.002	Hexachloro Butadiene	0.469
Benzyl Chloride	0.010	Hexachloro Ethane	0.025
Beryllium	1.26 ¹	Hydrazine 95%	0.500
Bis Chloromethyl Ether	0.005	Hydrazine Sulfate	1.34
Bis 2 Chloroethyl Ether	0.015	Isophorone	0.010
Bis 2 Ethylhexyl Phthalate	0.010	Lead	1,257
Bromoform	5.52	Lindane	0.002
Butyl Benzyl Phthalate	0.005	Methylene Chloride	300
Cadmium	29.1	Nickel	129
Carbazole	0.010	2-Nitropropane	0.010
Carbon Tetrachloride	7,059	N-Nitroso Diphenylamine	0.005
Chloranil	0.250	N-Nitroso Di N Propylamine	0.001
Chlordane	0.003	o-Phenylene Diamine	0.010
o-Chloroaniline	0.010	Quinoline	1.08
p-Chloroaniline	0.010	Sodium Diethyldithiocarbamate	0.237
Chlorodibromomethane	0.005	Styrene	0.128
Chloroform	499	Tetrachloroethane	0.025
Chromium VI	793	Tetrachloroethylene	0.030
Crotonaldehyde	0.010	o-Toluidine	0.010
4,4 DDD	0.001	p-Toluidine	0.010
DDE	0.001	Toxaphene	0.003
DDT	0.002	1,1,2-Trichloroethane	0.016
Dibenzo Furan	0.010	Trichloroethene	140
Dibromo Chloromethane	0.010	2,4,6-Trichlorophenol	0.011
o-Dichlorobenzene	0.015	Vaponite 2 Insecticide	18.9
p-Dichlorobenzene	0.010	Vinyl Chloride	0.004
1,2-Dichloropropane	0.030	Vinylidene Chloride	0.005
Dieldrin	0.003		

1 Quantity information for production related beryllium is classified. This value does not represent the total quantity of beryllium on site.

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TABLE 4-2
ADDITIONAL CARCINOGENS
AT ROCKY FLATS
FROM 1974 INVENTORY

Chemical	Quantity (Kilograms)
Azobenzene	0.020
Benzidine	0.025
Butadiene	113
Chloromethyl Aniline	0.020
Ethylene Oxide	192,400
Nitrogen Trioxide	57
Propylene Oxide	1.5

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TABLE 4-3

PESTICIDES AND HERBICIDES USED AT ROCKY FLATS

Arsenic	(likely an organic arsenical compound)
Banvel	(2-methoxy-3,6-dichlorobenzoic acid; Dicamba)
Dursban	(0,0-diethyl 0-(3,5,6 trichloro-2-pyridyl)-phosphorothioate; Chloropyrifos)
Karmex	(3-(3,4-dichlorophenyl)-1,1-dimethylurea; Diuron (80%))
Krovar 1/Hyvar X	(5-bromo-3-sec-butyl-6-methyluracil; Bromacil (40%)) (3-(3,4-dichlorophenyl)-1,1-dimethylurea)
Oust	(methyl 2 {{{{(4,6-dimethyl-2-pyrimidinyl) amino} carbonyl} amino} sulfonyl} benzoate; Sulfometuron Methyl)
Princep	(2-chloro-4,6-bis (ethyl amino)-s-triazine; Simazine)
Eerex	(3-(p-chlorophenyl)-1,1-dimethylurea trichloroacetate; Urox)
Surflan	(3,5-dinitro-N4,N4-dipropylsufanilamide; Oryzalin)
Tersan	(methyl-1(butylcarbomyl)-2-benzimidazole carbamate; Benomyl)
Tordon	(4-amino-3,5,6-trichloropicolinic acid; Picloram)
Ureabor	(sodium borate-66.5%; sodium chlorate-30%; bromacil-1.5%)
Velpar	(3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4-(1H,3H)-dione; Hexazinone)
Warfarin	(3(a-acetonylbenzyl)-4-hydroxycoumarin)

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4.3 Chemicals Identified from Document Searches

The list of chemicals prepared from the 1974 and 1988/89 inventories was checked by reviewing a large number of documents and interviewing a number of individuals. A partial listing of the documents reviewed and persons contacted is provided in Appendices E and F. As an indication of the completeness of the inventories of 1974 and 1988/89, the search of documents resulted in the identification of few chemicals not named on the inventories and a number of commonly used brand name products. The chemical and product names cited in a document but not found on the inventories are identified in Table 4-4. The chemicals identified on Table 4-4 are generally closely related to chemicals found on the chemical inventories. No quantitative data comparable to that provided in the inventories was available for these additional compounds.

4.4 Chemicals Identified as Major Use or of Principal Concern in Past Reports

A wide variety of reports have been prepared that deal with concerns related to chemical releases or contamination from Rocky Flats. A number of these reports are discussed here in the interest of establishing whether the chemical inventories that are the basis for the chemical listings generated for this task include the compounds that have been historically identified as of potential concern.

Two reports were identified which provided a listing of the important radionuclides and chemicals at the plant. The first is from the Governor's Scientific Panel and the second is the 1980 Environmental Impact Statement for the plant.

TABLE 4-4

CHEMICALS IDENTIFIED FROM OTHER DOCUMENTS

Compound	Document
Cadmium Cyanide	RCRA, Part B Operating Permit Application, 12/15/87
Bromine Trifluoride	RCRA, Part B Operating Permit Application, 12/15/87
Chlorine Trifluoride	RCRA, Part B Operating Permit Application, 12/15/87
Tungsten Pentafluoride	RCRA, Part B Operating Permit Application, 12/15/87
4-chloro-3-methyl phenol	Waste Stream Identification and Characterization April 1987
DHDECMP complexing agent	Waste Minimization and Assessment Report 12/19/90
Methyl Ethyl Ketone Peroxide	Fact Sheets and MSDS supplied by Howard Brown
Lithium Deuteride	Lithium Hydride and Lithium Deuteride Disposal EMF #60-10112-RR-008
Prestolite	SARA Title III Community Right to Know... 1989
Prestolite B	SARA Title III Community Right to Know... 1989
P-10	SARA Title III Community Right to Know... 1989
Medical Gas	SARA Title III Community Right to Know... 1989
Reillex HPQ	SARA Title III Community Right to Know... 1989
Lectra Clean	SARA Title III Community Right to Know... 1989
Polar Melt	SARA Title III Community Right to Know... 1989
Ice Melt	SARA Title III Community Right to Know... 1989
Salt Rock	SARA Title III Community Right to Know... 1989
Sand Squeegee	SARA Title III Community Right to Know... 1989
Conclude Fabric Softener	SARA Title III Community Right to Know... 1989
Premium Car Wash	SARA Title III Community Right to Know... 1989
Betz 2020	SARA Title III Community Right to Know... 1989
Betz 2040	SARA Title III Community Right to Know... 1989

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- Governor's Rocky Flats Scientific Panel on Monitoring Systems (October 1990). The Radiation and Air Committee reports identified important radionuclides and chemicals at the plant site. The Radiation Committee report suggested that primarily those radionuclides reported to be present in gram quantities or greater be the focus of monitoring efforts. The Radiation Committee relied primarily on the same plant inventories used to construct the listing for this task, therefore no additional radionuclides were reported. The Air Committee of the Governor's Panel relied on SARA Title III reports for 1988 from the plant to identify the top 19 hazardous materials and to make recommendations regarding monitoring systems for these chemicals. Each of these 19 materials were found on the chemical inventory presented in the Appendices of this report with the exception of methylene bis(phenyl isocyanate) - MDI (Diphenylmethane- 4,4'-diisocyanate), a resin or epoxy component which may be reported under a product name in the inventory (Appendix B). The panel estimated that there are no air emissions of MDI from the plant. The annual usage quantities for the 19 materials presented in the panel's report (based on the SARA Title III reporting) are generally about ten times higher than the quantities reported in the 1988/89 inventory, suggesting that the inventory quantities identified in the Appendices of this report may represent about one month's supply of the material.
- Final Environmental Impact Statement for the Rocky Flats Plant Site (April, 1980). This report identified 42 major chemicals and the typical annual consumption rates of each in 1977. All 42 of the chemicals were present on the lists presented in the Appendices.

A variety of reports address the identification and clean-up of chemicals released to the environment by the plant. These reports present an opportunity to evaluate whether chemicals detected in the environment are consistent with those found on the plant inventories. The following three reports were reviewed for the purposes of establishing whether the contaminants of concern for remediation have been included in the plant chemical inventories:

- Remedial Investigation Report for High Priority Sites (881 Hillside), Volume 1, 3/1/88

- Solar Evaporation Ponds, Closure Plan, Volume 1, 7/1/88
- Remedial Investigation Report for 903 Pad, Mound and East Trenches Area, Volume 1, 12/31/87

Table 4-5 lists the contaminants of concern identified by these reports for various areas of the plant site.

Each of the chemical contaminants identified in the table is listed on the chemical inventory presented in the appendices (metals are included as a constituent of a number of compounds on the inventory).

4.5 Summary

The primary objective of this Task 1 effort has been the identification of the radionuclides and chemicals that have been used at Rocky Flats over the past 40 years. As part of the investigation, additional information regarding inventory quantities and the nature of some of the materials was identified and presented as part of this report.

A fairly complete and consistent record of radionuclide use has been maintained by the plant, and in conjunction with environmental monitoring data suggests a relatively complete picture of the radionuclides historically present at the plant.

Comprehensive records regarding historic chemical use are limited to inventories prepared in the mid-1970s and the late 1980s. A considerable number of documents were reviewed to determine whether there was evidence of substantial use or presence of chemicals not

TABLE 4-5

CONTAMINANTS IDENTIFIED ON-SITE AT ROCKY FLATS

881 Hillside

Trichloroethylene (TCE)
 Perchloroethylene (PCE)
 Trichloroethane (TCA)
 Dichloroethylene (DCE)

East Trenches

TCE
 PCE

903 Pad

TCE
 PCE
 Carbon Tetrachloride (CCl₄)
 DCE
 Chloroform

Solar Ponds

nitrate
 cyanide
 beryllium
 acetone
 PCE
 methylene chloride
 chromium
 calcium
 magnesium
 aluminum
 copper
 iron
 potassium
 sodium
 nickel
 tin
 plutonium
 americium
 uranium
 tritium

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found on these inventories, and to identify any documentation of significant process changes that may have marked dramatic changes in chemical usage at the plant. The document review did not result in the identification of any information suggesting major process changes that were linked to significant changes in the chemicals used over time. Interviewees suggested that there is constant change and adjustment in various processes, and also indicated that process changes apparently affected the accuracy of the waste stream characterization reports over a short period of time. However, nothing that was reviewed for the purposes of this task suggested that any changes could be identified that alone have dramatically altered general chemical usage at the facility with two exceptions. The first dramatic change involved the introduction of machining methods employing lubricants in the late 1950s to what had previously been a dry process. The second change, also in the 1950's involved changes in the form (liquid, powder, solid) of the plutonium used by the plant. The source of the differences in the inventory quantities between 1974 and 1988/89 for some chemicals may, in many cases, be linked to the general trends in industry to reduce the usage of some specific carcinogenic compounds in favor of less toxic substitutes.

The document review performed for this task suggested that the inventories included the majority of the chemicals cited in other documents, but also indicated that commercial product names not listed in the inventory are likely to be continually encountered in documents. Also, references to chemicals not on the inventories are also likely to be found with no reference to their potential importance or use at the plant site. In many cases references to chemicals that on first look were not on the inventory, were found after further investigation under a synonym for the chemical. In other cases there were many closely related compounds, each representing distinct chemicals, but potentially used interchangeably, behaving similarly in the environment and having similar toxic properties. These observations suggest that while chemical changes may appear to have taken place,

many times such changes have no practical impact on the nature of a potential chemical release and its ultimate impact on the environment.

Therefore, while the picture of chemical use at the facility in many ways appears to be extremely complex, overall the general nature and type of compounds used in quantity at the facility have been relatively stable. A key objective of future investigations for this project will be to further detail the historic use of selected chemicals at the site to refine our understanding and to evaluate the nature of potential releases.

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